For Performance Measurement

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

STATISTICS 6046/1

PAPER 1

SPECIMEN PAPER 3 hours

Additional materials:
Answer paper
Graph paper
List of Formulae
Electronic calculator

TIME 3 hours

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces provided on the answer paper/ answer booklet.

Answer **all** questions.

If a numerical answer cannot be given exactly, and the accuracy required is not specified in the question, then in the case of an angle it should be given to the nearest degree, and in other cases it should be given correct to 2 significant figures.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 120.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

This specimen paper consists of 6 printed pages and 2 blank pages.

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1 In a group of 40 students all of whom are studying Statistics or Pure Mathematics or both, 20 are studying Statistics and 30 are studying Pure Mathematics.

(a) Illustrate the information on a Venn diagram. [1]

(b) Find the probability that a student chosen at random is

(i) studying Statistics and Pure Mathematics,

(ii) studying Pure Mathematics but not Statistics.

[4]

2 Four letters are chosen at random the word DARLING. Find the probability that

(a) exactly 2 consonants are chosen. [2]

(b) at least 3 consonants are chosen. [3]

3 The life span, in years of a randomly chosen car battery is normally distributed with mean 2 and standard deviation 0.4.

(a) Show that a randomly chosen car battery has a life span less than a year is 0.0062. Correct to 4 decimal places. [2]

(b) A car battery dealer, buys 500 randomly chosen car batteries.

Using a suitable approximation. Find the probability that at most three batteries have a life span less than a year. [4]

4 Cars arrive at a service station at an average rate of 2 per 5 minutes interval.

Assuming that the cars follow a Poisson distribution find the probability that

(i) no cars arrive during a 5 minutes interval,

(ii) at least 3 cars arrive in the next 15 minutes.

[6]

5 **(a)** Give 2 examples of situations that can be modelled by an exponential distribution. [2]

(b) A dart player aims at the bull's eye. The distance X cm from the bull's eye at which the arrow strikes the dart board has a probability density function defined by

$$f(x) = \begin{cases} \frac{1}{10} e^{-\frac{x}{10}}, & x > 0 \\ 0, & Otherwise \end{cases}$$

An arrow scores 8 points if $X \leq 2$, 5 points if $2 < X \leq 5$ and 1 point if $5 < X \leq 15$ and no points otherwise

(i) Construct the probability distribution table for the scores.

(ii) Find the expected score when one arrow is shot at the bull's eye.

[6]

6 A shop's quarterly electricity bill, $, over a period of 3 years were as follows:

Year	Q_1	Q_2	Q_3	Q_4
1	112	137	161	154
2	133	147	188	161
3	163	184	209	201

(i) Plot these data on a time series graph. [3]

(ii) Calculate 5 point moving averages for the data. [3]

(iii) Plot the 5 point moving averages on the graph in **(i)**. [2]

7 **(a)** Define Type 1 and Type II errors in testing hypotheses. [2]

(b) A random observation is taken from a binomial distribution $X \backsim \text{Bin}(12, p)$, and used to test the null hypothesis $p = 0{,}7$ against the alternative $p > 0{,}7$.

The critical region is chosen to be $x \geq 11$.

Find the **(i)** significance of the test.

(ii) probability of making a Type I error

(iii) probability of making a Type II error if $p = 0{,}75$.

[6]

8 Of the 300 graduands from a college, 120 failed to get employment.

(a) Calculate:

(i) The percentage of graduands who failed to get employment.

(ii) A 97% confidence interval for the proportion of graduands who failed to get employment. [4]

(b) Find the sample size that would have been taken in order to estimate the percentage to within ±3% with 97% confidence. [4]

9 The table below shows the weekly wages ($x) of 100 employees.

Wages $x	45-55	55-65	65-75	75-85	85-95	95-105	105-115	115-125	125-135
Frequency	1	1	2	6	21	29	24	12	4

(a) **(i)** Construct a cumulative frequency table.

(ii) Draw a cumulative frequency curve.

[6]

(b) Use your graph to estimate:

(i) The number of workers who earn a wage greater than $80.

(ii) x, if 20% of the employees earn more than $x. [3]

10 A continuous random variable X has a probability density function given by

$$f(x) = \begin{cases} -kx & -2 \leq x \leq 0 \\ kx & 0 \leq x \leq 2 \\ 0 & otherwise \end{cases}$$

where k is a constant.

(a) Sketch the graph of f(x) and hence find the value of k. [4]

(b) Calculate Var(X) [2]

(c) A random sample of 200 observations of X is taken, find the probability that the sample mean exceeds 0.2. [3]

11 A school has two photocopiers X and Y . the number of times per week that X breaks down has a Poisson distribution with mean 0.3, while independently the number of times that Y breaks down in a week follows a Poisson distribution with mean 0.2.

Find the probability that in the next 4 weeks.

(i) X will not breakdown at all. [4]

(ii) There will be a total of 3 breaks down. [3]

(iii) Each photocopier will breakdown exactly twice. [3]

12 Ten boys compete in throwing a cricket ball, and the table shows the height of each boy (x cm) measured to the nearest centimetre and the distance (Y m) to which he can throw the ball.

Boys	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
x	122	124	133	138	144	156	158	161	164	168
y	41	38	52	56	29	54	59	61	63	67

$\sum x = 1\,468; \qquad \sum x^2 = 218\,070; \qquad \sum y = 520$

$\sum y^2 = 28\,382; \qquad \sum xy = 77\,689$

Calculate

(i) The regressions line y on x and x on y.

(ii) Coefficient of determination and comment on its significance.

[12]

13 A college claims that the performance in Mathematics for their non formal learners depends on the time of day during which they had their lessons. A group of 160 learners gave the following results.

Time of day	Performance	
	Pass	Fail
Morning	40	30
Afternoon	44	10
Evening	20	16

Test the claim at the 5% level of significance. [13]

14 The data below were collected about the diameters (cm) of 80 plebbles.

Diameter	**Number of pebbles**
< 1.8	3
$1.8 - 2.2$	17
$2.2 - 2.6$	33
$2.6 - 3$	22
≥ 3	5

Test at 1% of significance whether the diameters follow a normal distribution with $\mu = 2.44$ and $\delta = 0.4$. [13]

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